Fujitsu Semiconductor Europe GmbH

SOFTWARE DEVELOPMENT PLATFORM

USER MANUAL

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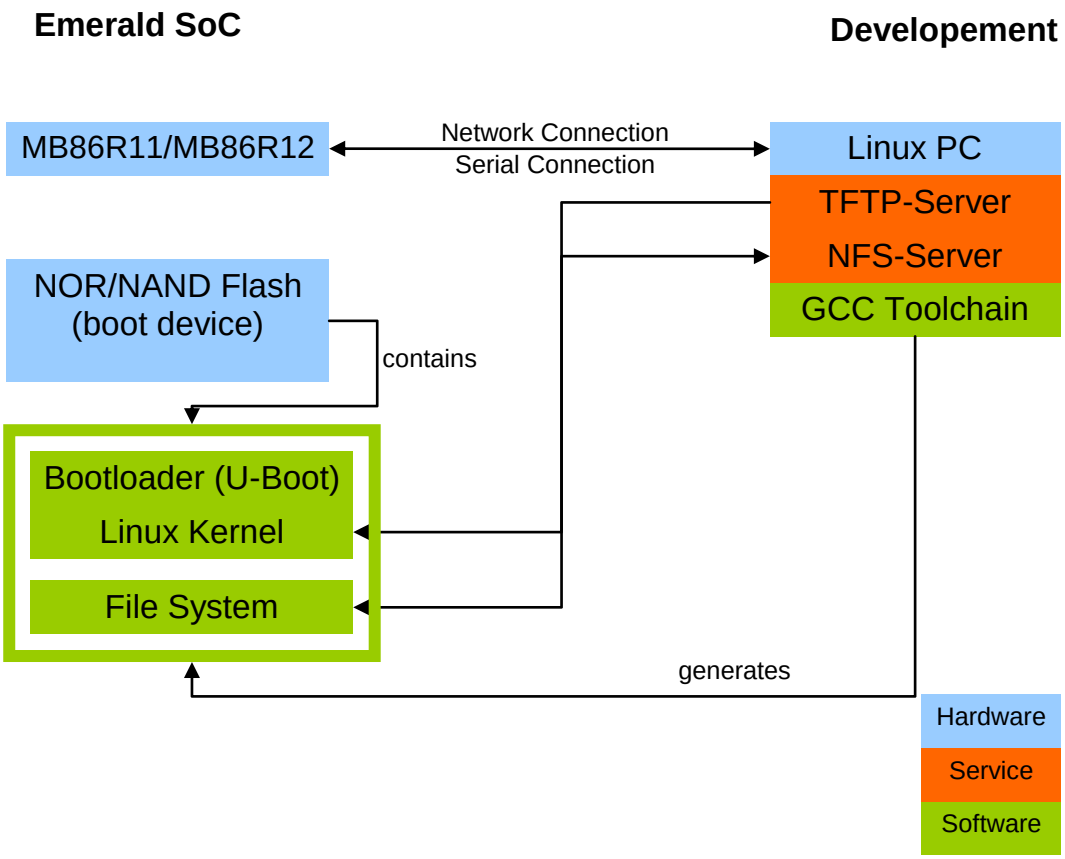
1 System Overview

This chapter should help the user to understand the basic concepts to develop software for an Emerald Linux system.

1.1 General

The Development Platform is based on a PC (development host) with a Linux OS, either installed native or within a virtual machine. Typically the development host contains the server infrastructure like nfs- and tftp-server to act as resource for the target's file system and Linux kernel provider. The development host features a GCC toolchain. This is used to generate the content of a file system for the target (MB86R11/MB86R12).

The delivered system will execute the Linux kernel from NOR flash after the system is initialised by the Bootloader. A sample file system is located in the NAND flash. This is mounted by the kernel. An init-process will be called from the Linux kernel as last step of the kernel initialisation sequence. The process is part of the file system. The picture below shows the HW/SW-architecture of the Emerald Linux System.



1.2 Network connection configuration

The development system and the emerald evaluation board are connected within a private network. The network is built upon tcp-ip.

For application development it is necessary to mount the file system over an nfs connection. To achieve this, the development host should carry a separate network card dedicated to this network with the following configuration:

IP-Address 169.254.148.045
Network Mask 255.255.000.000

The target is configured with the following setup:

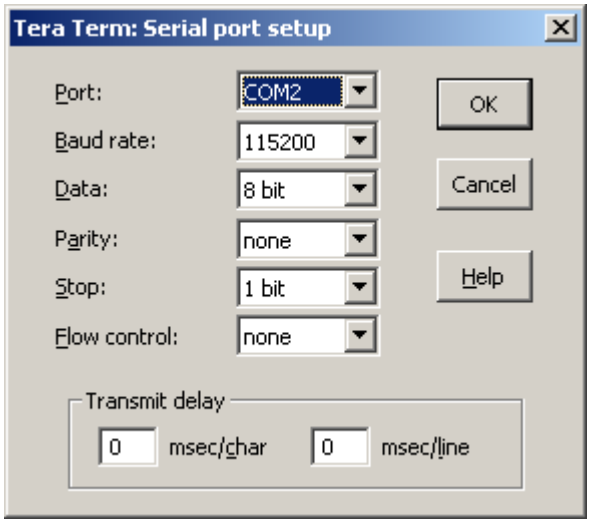
IP-Address 169.254.148.043

Network Mask 255.255.000.000
Server IP 169.254.148.045

Gateway IP 169.254.148.045

1.3 Serial connection configuration

The development system and the emerald prototype should be connected via a serial line to display boot messages and be able to enter configuration commands. You can use a common terminal program (for example Tera Term **http://www.ayera.com/teraterm/**). A configuration for Tera Term is shown in the picture below and can be reached via the menu 'Setup->Serial port'



1.4 Remarks on this document

For installation and configuration purpose some content is formatted to be used as an example. Most of the installation/configuration is based on terminal usage, so almost all commands will be entered in a terminal program. Two different prompts exist:

The first one is U-Boot (Bootloader) prompt formatted like: `emerald>`
The second one is the Linux terminal prompt formatted like: `$>`

On the development host a user named “linux”, password “user” is used as an example configuration.

2 Development Platform

2.1 Host configuration

Fujitsu is using a virtual machine as a development host. It's configured with Ubuntu Linux version 10.04 LTS (**http://www.ubuntu.com/getubuntu/download**). The user manual mentioned in section 1.4 can help with further configuration and is a good starting point to prepare the development host and understand the requirements.
Ensure that an nfs and tftp server is running on your host machine. The tftp-server acts as a kernel source for booting the target and for file transfers to the target as used in all update procedures (please check chapter 0 for details).

Normally you can use any Linux distribution you prefer, as long as all requirements above are met.

2.1.1 Toolchain installation

The toolchain contains a GCC 4.3.3 C/C++ compiler with glibc 2.9. Please install the toolchain with the commands below. You need to be user "root" to do this. In these instructions we assume a user named "linux" should operate the toolchain after installation.

```
$> sudo mkdir /opt/pb-a8
$> sudo chown linux /opt/pb-a8
$> sudo chgrp linux /opt/pb-a8
```

Now user "linux" can install the toolchain to directory /opt/pb-a8. '{src}' is the directory where the archive is located.

```
$> cd /opt/pb-a8
$> tar xvjf {src}/arm-angstrom-linux-gnueabi-gcc.4.3.3.tar.bz2
$> mkdir staging
$> cd staging
$> tar xvjf {src}/armv7a-angstrom-linux-gnueabi.tar.bz2
```

2.1.2 File system installation

The file system is build with OpenEmbedded (**http://www.openembedded.org**).

Please check Emeralds BSP download section for updates.

http://www.fujitsu.com/emea/services/microelectronics/gdc/swtools/gdc-software-index.html

Please install the file system with the commands below and export the directory /opt/emerald/nfsroot with your nfs-server. If you use BSP2.1 or later this step is not necessary as the target will boot the filesystem from a flash device.

```
$> mkdir /opt/emerald
$> cd /opt/emerald
$> sudo tar xvjf {path to}/emerald.rootfs.{release}.{version}.tar.bz2
$> cd /opt/emerald/nfsroot/lib
$> sudo tar xvjf {path to}/emerald.modules.{release}.{version}.tar.bz2
```

2.1.3 Linux Kernel

A Linux Kernel version 3.0.3 is used on the target. The kernel source can be downloaded from the Internet **http://www.kernel.org/pub/linux/kernel/v3.0/linux-3.0.3.tar.bz2**.

It is modified to meet Emerald's HW specification. The source modification can be obtained from Fujitsu Semiconductors GmbH. Please check the Emerald BSP download section.

http://www.fujitsu.com/emea/services/microelectronics/gdc/swtools/gdc-software-index.html

If drivers should be compiled, or the kernel itself should be modified, the kernel source tree must be installed. You can extract the archive to your preferred location {destination directory}. Note that some driver makefiles must be changed, when they reference the kernel source tree.

```
$> cd {destination directory}
$> tar xvjf {path to}/linux-3.0.3.tar.bz2
```

The kernel source code modification is distributed in the same structure as the kernel source itself. Please extract the archive as below.

```
$> tar xvjf {path to}/emerald-{release}-{version}-linux-3.0.3.tar.bz2
```

3 Emerald HW/SW configuration

3.1 MB86R11

CPU: ARM CortexA9 @400 MHz

Memory: DDR2 Ram, 256 MB

3.2 MB86R12

CPU: ARM CortexA9 @400 MHz

Memory: DDR3 Ram, 512 MB

3.3 U-Boot configuration

U-Boot is used to boot the Linux operating system. It can automatically boot Linux, when a boot command is present in the environment. U-Boot supports at least three different configurations.

1. A Configuration to boot the file system from NAND Flash.
   The bootloader boots the kernel from NOR-flash, file system location is NAND-flash

```
emerald> setenv bootcmd 'run nandboot'
emerald> saveenv
```

2. Configuration to boot the file system from network.
   The bootloader boots the kernel from NOR, file system location is nfs

```
emerald> setenv bootcmd 'run nfsboot'
emerald> saveenv
```

3. Configuration to boot the kernel and the file system from network.

Configuration 2 is typical to develop an application, as long as the kernel shouldn't be modified. For stand alone applications & demonstrations use configuration 1.

The U-Boot environment is the place, where these configurations are saved. Typically there are two configurations present, when you receive the evaluation board. Below you can find the commands to modify or setup the configurations.

```
emerald> setenv ipaddr 169.254.148.43
emerald> setenv serverip 169.254.148.45
emerald> setenv gatewayip 169.254.148.45
emerald> setenv netmask 255.255.0.0
emerald> setenv ipconfig ''
emerald> setenv cpumem 'mem=64M'
emerald> setenv gpumem 'gpumem=192M'
emerald> setenv console 'console=ttyS0,115200n8 earlyprintk=ttyS0,115200'
emerald> setenv bootargs_nand 'root=/dev/mtdblock4 rw rootfstype=jffs2
lpj=3997696'
emerald> setenv bootargs_nfs 'root=/dev/nfs rw nfsroot=169.254.148.45:/opt/
emerald/nfsroot/ rw lpj=3997696'
emerald> setenv nandboot 'setenv bootargs ${bootargs_nand} ${cpumem} ${gpumem}
${console} ip=${ipaddr}:${serverip}:${gatewayip}:${netmask}:::off;bootm
e0100000'
emerald> setenv nfsboot 'setenv bootargs ${bootargs_nfs} ${cpumem} ${gpumem}
${console} ip=${ipaddr}:${serverip}:${gatewayip}:${netmask}:::off;bootm
e0100000'
```

3.4 Emerald specific U-Boot environment variables

Some Emerald specific environment variables are defined, to give the user easy access to control the system behavior. The system is configured with these settings, before the user can gain access via a shell prompt.

'tcon_pinctrl': Can be used to setup the driver strength of the TCON-output-pad cells. (Default: 90)

'pinmux': Defines Emerald Peripheral settings (Default: 80000000). Please check the hardware-manual for register description.

'MCR_63': Set DDR access priority for AXI0 (XXXXWWRR) - CAP/DISP

'MCR_64': Set DDR access priority for AXI1 (WWRRXXXX) - CAP/DISP

'MCR_65': Set DDR access priority for AXI2 (RRXXXXXX) - PIXENG/ARGES

'MCR_66': Set DDR access priority for AXI2 (XXXXXXWW) - PIXENG/ARGES

'MCR_67': Set DDR access priority for AXI3 (XXXXWWRR) - PIXENG/ARGES

'MCR_68': Set DDR access priority for AXI4 (WWRRXXXX) - CPU

A recommended setting is to keep the default (=lowest) priority 2 for PIXENG/ARGES, but change to priority 1 for the rest. Please check the hardware-manual for complete register description.

```
emerald> setenv MCR_63 00000101;setenv MCR_64 0101FFFF;setenv MCR_68 0101FFFF
```

3.5 U-Boot Linux Kernel parameter

This chapter is an introduction how to pass parameters to the Linux kernel in U-Boot. In addition you will find an overview of the parameters used in an Emerald Linux system.

In U-Boot all parameters passed to the Linux kernel are collected in an environment variable named ‘bootargs’. If you like to have only one boot configuration, the easiest way is to set this variable directly. Normally you like to have two configurations as mentioned in the previous chapter. For this reason the environment variable ‘bootargs’ can be constructed at runtime. Linux Kernel parameters are always passed in the format ‘name=value’. The Linux kernel requires several parameters to operate:

‘root’: A location from where it can mount the root file-system (mandatory)

Example: root=/dev/mtdblock4 rw

Example: root=/dev/nfs rw

‘nfsroot’: The IP-address of an nfs-server followed by the exported directory (mandatory if root=/dev/nfs)

Example: nfsroot=${serverip}:${nfs_path}

‘rootfstype’: The filesystem type of the partition (mandatory if root=/dev/mtdblock?)

Example: rootfstype=jffs2

‘console’: The device-name and configuration, where the initial console can be opened (mandatory)

Example: console=ttyS0,115200n8

‘ip’: The IP configuration of the target device (mandatory if root=/dev/nfs or an ssh-server should run on the target)

Example: ip=${ipaddr}:${serverip}:${gatewayip}:${netmask}:::off

‘init’: An initial process to start, after the root-file-system is mounted. (Optional)

This can be used to minimize the start-up time by running your application as initial process. The example below will boot the kernel and just run a shell.

Example: init=/bin/sh

‘earlyprintk’: A UART-device, where debug output can be redirected, before the console-driver is started (optional)
Example: earlyprintk=ttyS0,115200

‘mem’: The amount of memory the Linux kernel will use (mandatory if you want to use the Emerald Graphic Driver)
Example: mem=64m -> will map the first 64 megabytes of memory.

‘gpumem’: The amount of memory to be reserved for Emeralds GPU (mandatory if you want to use the Emerald Graphic Driver)

Example: gpumem=64m -> will map 64 megabytes of memory.

Note: ‘mem’ and ‘gpumem’ share the memory on the CPU-Board. Currently 256 MB (512MB on Emerald-P boards) are assembled. During boot up, Linux will start mapping the amount of memory supplied with ‘mem’ or all available memory if ‘mem’ isn’t present. When the memory mappings overlap (mem + gpumem > assembled Memory), the graphic driver can’t be loaded.

3.6 Target Linux distribution

The BSP features an Ångström distribution on top of Linux kernel 3.0.3 as operating system. For more information about this distribution please check

http://www.angstrom-distribution.org

The root filesystem, which is mounted by the kernel, features a serial console login as well as an ssh-login. A user named ‘root’ can login to the system, a password isn’t required. All drivers, which aren’t needed at boot time, are compiled as modules. Typically they are present in the root filesystem, from where they can be loaded.

As mentioned before, the content of the root filesystem is generated with the OpenEmbedded build framework. Fujitsu choose to deliver a minimal filesystem and a SDK. Using this, you can evaluate the

platform. When you miss some libraries or applications, these can be added by using the complete build framework. This is based on git-repository with cross-compiling information. Instructions how to setup the build framework can be obtained from the OpenEmbedded website **www.openembedded.org**. Please check the documentation on the website for system requirements.

In addition Fujitsu maintains some modifications for Emerald. These modifications can be used as a local overlay to the git-repository.

4 Application/Linux Kernel development

4.1 Build Preparation

The current root filesystem distributed within the BSP includes a set of shell commands. Complex application are not included, but can be evaluated by the using the graphics driver package. As we are using cross-compilation to build the kernel or any application, the environment must be modified.

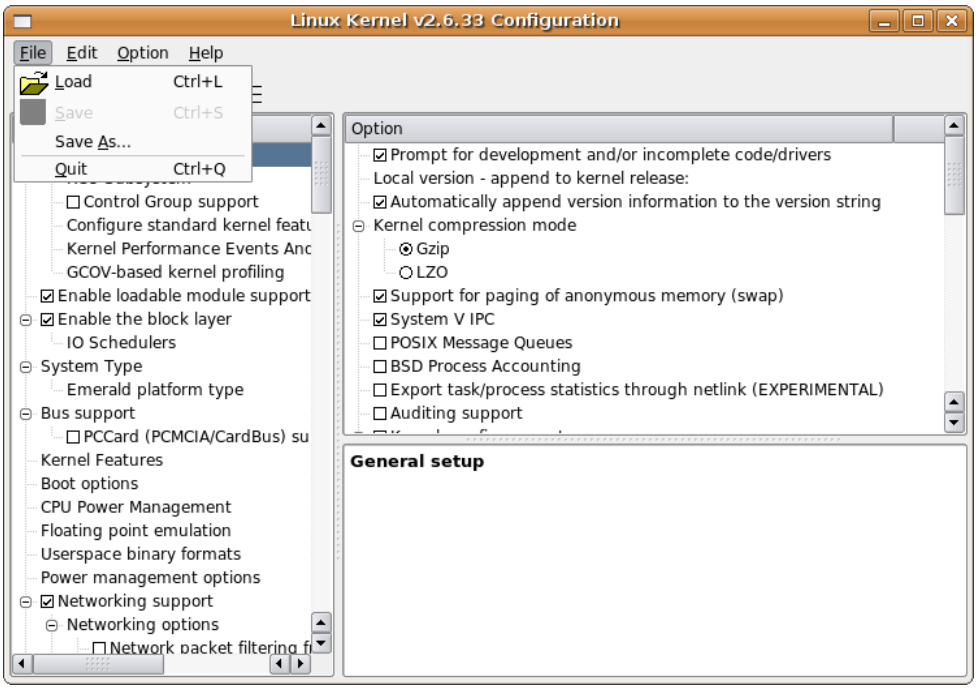
```
$> export PATH=$PATH:/opt/pb-a8/cross/armv7a/bin/
$> export ARCH=arm
$> export CROSS_COMPILE=arm-angstrom-linux-gnueabi-
```

4.1.1 Build Procedure Linux Kernel

The source distribution contains some Linux Kernel configurations. These should be used to configure and build a Linux Kernel for Emerald. You can start a graphical kernel configuration by using the command below.

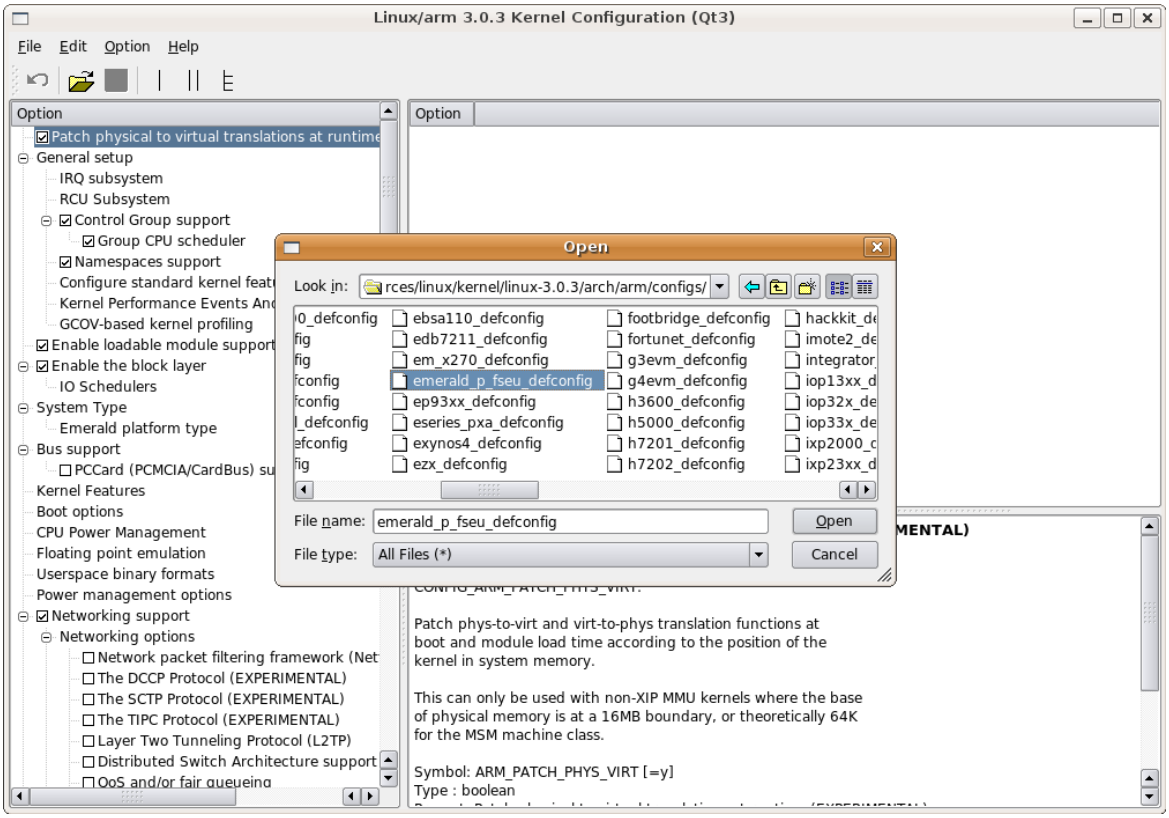
$> make xconfig

Once the application is started, choose File->Load to select a kernel configuration file:



The configuration files are located in the folder ‘arch/arm/configs’. All valid configurations are prefixed with

'emerald'. We advise you to use the configuration 'emerald_p_fseu_defconfig'. This config can also be used to build a kernel for MB86R11, when the Board is delivered with BSP_v3.0.0 or later.



Now choose 'File->Save' and 'File->Quit' to make the new configuration active.

To build drivers as modules, the kernel source tree needs to be prepared:

```
$> make modules_prepare
```

Now the Kernel can be build:

Default configuration

```
$> make uImage
```

The Kernel-image can be found in 'arch/arm/boot'. It's named 'uImage'.

Please check the chapter NOR-/NAND-Flash usage for installation instructions.

To build all driver modules type:

```
$> make modules
```

To install all driver modules type:

```
$> sudo make ARCH=arm INSTALL_MOD_PATH={path_to_nfsroot} modules_install
```

4.1.2 Build Procedure Application

Please check the graphic driver package for details about the build procedure.

4.2 Application installation (NFS-File system)

Demo applications and all related files are installed in the NFS-File system for verification purpose. Normally you will copy the application to the directory home/root

```
$> sudo cp {path_to_application}/* /opt/emerald/nfsroot/home/root/
```

It is useful to prepare a script, which will load additional drivers and start your application. This script can be reused later to start your demo automatically.

4.3 Application installation (NAND flash / USB memory device)

To run the application on a target without a network-connection, the application and corresponding files need to be transferred to Emerald flash memory. One method is to modify the root filesystem itself, another possibility is to install just the application on an USB memory device.

4.4 System start-up

4.4.1 Root Filesystem preparation

The root filesystem is configured to run a default application after system setup. The behaviour can be controlled by the file ‘etc/inittab’ included in the root filesystem.

Normally a login shell is started by default. In a standalone or demo configuration it’s more reasonable to start an initialisation script, which will load additional drivers and start the application. To do this, enable the last line in ‘etc/inittab’ and let it point to a script you prepared to start your application. If you don’t like to have a serial login, disable any line which will start a ‘getty’-process on a serial line. An example ‘/etc/inittab’ file is listed below. The ‘/etc/inittab’ will start a serial console on UART0. This enables the user to login to the system and start application debugging. This is the default configuration before BSP 2.1 release.

```
# /etc/inittab: init(8) configuration.
# $Id: inittab,v 1.91 2002/01/25 13:35:21 miquels Exp $

# The default runlevel.
id:3:initdefault:

# Boot-time system configuration/initialization script.
# This is run first except when booting in emergency (-b) mode.
si::sysinit:/etc/init.d/rcS

# What to do in single-user mode.
~~:S:wait:/sbin/sulogin

# /etc/init.d executes the S and K scripts upon change
# of runlevel.
#
# Runlevel 0 is halt.
# Runlevel 1 is single-user.
# Runlevels 2-5 are multi-user.
# Runlevel 6 is reboot.

l0:0:wait:/etc/init.d/rc 0
l1:1:wait:/etc/init.d/rc 1
l2:2:wait:/etc/init.d/rc 2
l3:3:wait:/etc/init.d/rc 3
l4:4:wait:/etc/init.d/rc 4
l5:5:wait:/etc/init.d/rc 5
l6:6:wait:/etc/init.d/rc 6
# Normally not reached, but fallthrough in case of emergency.
z6:6:respawn:/sbin/sulogin
#disable the line below to not start a serial login
S0:2345:respawn:/sbin/getty 115200 ttyS0
```

```
# /sbin/getty invocations for the runlevels.
#
# The "id" field MUST be the same as the last
# characters of the device (after "tty").
#
# Format:
#  <id>:<runlevels>:<action>:<process>
#
# enable the line below to run /home/root/startup.sh
#2:2345:once:/home/root/startup.sh
```

To automatically start the application after system boot, change '/etc/inittab' as below. This is the default configuration since BSP 2.1 release.

```
# /etc/inittab: init(8) configuration.
# $Id: inittab,v 1.91 2002/01/25 13:35:21 miquels Exp $

# The default runlevel.
id:3:initdefault:

# Boot-time system configuration/initialization script.
# This is run first except when booting in emergency (-b) mode.
si::sysinit:/etc/init.d/rcS

# What to do in single-user mode.
~~:S:wait:/sbin/sulogin

# /etc/init.d executes the S and K scripts upon change
# of runlevel.
#
# Runlevel 0 is halt.
# Runlevel 1 is single-user.
# Runlevels 2-5 are multi-user.
# Runlevel 6 is reboot.

l0:0:wait:/etc/init.d/rc 0
l1:1:wait:/etc/init.d/rc 1
l2:2:wait:/etc/init.d/rc 2
l3:3:wait:/etc/init.d/rc 3
l4:4:wait:/etc/init.d/rc 4
l5:5:wait:/etc/init.d/rc 5
l6:6:wait:/etc/init.d/rc 6
# Normally not reached, but fallthrough in case of emergency.
z6:6:respawn:/sbin/sulogin
# enable the line below to start a serial login
#S0:2345:respawn:/sbin/getty 115200 ttyS0
# /sbin/getty invocations for the runlevels.
#
# The "id" field MUST be the same as the last
# characters of the device (after "tty").
#
# Format:
#  <id>:<runlevels>:<action>:<process>
#
# disable the line below to not run /home/root/startup.sh
2:2345:once:/home/root/startup.sh
```

In the example above the '/etc/inittab' will start the shell-script 'startup.sh' located in '/home/root'.This shell-script can prepare the system to start your demo-application.

4.4.2 New System behavior after Emerald-L BSP2.1 installation and later

From this release on the system behavior is controlled with an attached USB-memory device. Either a development- or a demonstration-mode can be selected. The idea is that the target remains in one configuration, regardless what the user likes to do. To switch between different operations, a removable media should be used.

4.4.3 System behavior for Emerald-P BSP_v3.0.0, BSP_v3.0.1

As there is a problem with the external USB-Controller, mass storage devices don't work to control the startup behavior. Due to this, the startup can be controlled by the file '/home/root/startup.sh'. The file is stored in the NAND-flash. You can edit this file by connecting to the system via a console. The demo application can be stopped by pressing "Enter". After this the system tries to connect to a NFS-server, which can be configured. Setting 'demo_mode' to zero will not start the demo application. Setting 'timeout' to zero will skip the detection of an USB-memory device to be mounted. Due to the USB mass storage problem, this is currently the default.

```
#/home/root/startup.sh

#configure demo-mode on (1) or off (0)
demo_mode=1

#configure NFS server IP
server_ip="169.254.148.45"

#configure exported nfs directory
nfs_dir="/opt/emerald/nfsroot"

#configure target home directory (will be created)
home_dir="/home/dev"

#set timemout to zero to skip usb-sequence
timeout=0

#configure device to be mounted on usb-stick
device="/dev/sda1"

if [ "$demo_mode" = 1 ]
then
 modprobe emerald_display
 ./home/root/demo/dashboard/dashboard -r 800
 let timeout=0
fi

emerald_p=`/home/root/tools/emerald_probe -chipversion`
if [ $timeout -ne 0 ]
then
```

```
 if [ $emerald_p == "Emerald-P" ]
 then
       modprobe isp1760
 else
       modprobe ehci-hcd
       modprobe ohci-hcd
 fi
 modprobe usb-storage
fi
echo " "
until [[ -b "$device" || "$timeout" = 0 ]]; do
 echo -e "\rTrying to mount an usb-memory device for $timeout seconds \c"
 sleep 1
 let timeout-=1
done

if [ "$timeout" = 0 ]
then
 echo -e "\rUnable to mount an usb-memory device                  \n"
 echo -e "Try to mount $home_dir over NFS\n"
 mkdir -p $home_dir
 mount -t nfs $server_ip:$nfs_dir $home_dir -o nolock
 while [ true ]; do
       getty -L 115200 ttyS0 vt100
 done;
else
 mount $device
 if [ -f /media/usb/startup.sh ]; then
       cd /media/usb
       chmod 777 /media/usb/startup.sh
       /media/usb/startup.sh
 else
       echo -e "\rUnable to execute /media/usb/startup.sh\n"
       while [ true ]; do
             getty -L 115200 ttyS0 vt100
       done;
 fi
fi
```

4.4.4 Start-up using an USB-memory device

This example shows how to operate an USB-memory device and start a shell script from the attached media, which will enable the user to configure the target for development or demonstration. It will initially load drivers for USB-host controllers and USB-storage. Afterwards it will try to mount a partition on the USB-memory device and start a shell script named ‘startup.sh’. If no USB-memory device is attached, it will stop after 10 seconds and run a login shell. The file should be named ‘startup.sh’ and be placed in ‘/home/root’ from your root filesystem to correspond with the content of ‘/etc/inittab’:

```
 modprobe ehci-hcd
 modprobe ohci-hcd
 modprobe usb-storage
 device0="/dev/sda"    # /   (root directory)
 c=10
```

```
echo " "
until [[ -b "$device0" || "$c" = 0 ]]; do
echo -e "\rTrying to mount a usb memory device for $c seconds \c"
sleep 1
let c-=1
done
if [ "$c" = 0 ]
then
echo -e "\rUnable to mount a usb memory device                \n"
while [ true ]; do
/sbin/getty 115200 ttyS0
done;
else
mount /dev/sda1
if [ -f /media/usb/startup.sh ]; then
     cd /media/usb
     /media/usb/startup.sh
else
     mount /dev/sda
     cd /media/usb
        /media/usb/startup.sh
fi
fi
```

4.4.5 Sample Application start-up shell script on USB-memory device

The shell script, your demo application and all related files should be present on the USB-memory device. In this example the shell-script will load the graphic-driver kernel module and start the application. The script needs to be in the root-directory of the device. The filename must be ‘startup.sh’.

```
modprobe emerald_display
chmod +x multisample
./multisample
```

4.4.6 Development start-up shell script on USB-memory device

The shell script should be present on the USB-memory device. In this example the shell-script will create a directory to mount an nfs-share from the nfs-server with IP 169.254.148.45. The directory exported is ‘/opt/emerald/sources’ on the machine running the nfs-server. Afterwards a login shell is started

```
mkdir /home/root/sources
mount –t nfs 169.254.148.45:/opt/emerald/sources /home/root/sources –o
nolock
while [ true ]; do
/sbin/getty –L 115200 ttyS0 vt100
done;
```

4.4.7 Root Filesystem creation

A root filesystem for the emerald target can be created with the mtd-tools package (revision 1.50).

256mb Nand Flash

```
> sudo mkfs.jffs2 --root=nfsroot -l -v -n -e 128 -o temp.jffs2
> sudo sumtool -l -v -n -e 128 -p -i temp.jffs2 -o emerald.rootfs.nand.jffs2
```

64mb Nor Flash:

```
> sudo mkfs.jffs2 --root=nfsroot -l -v -e 128 -c 12 –o
emerald.rootfs.nor64.jffs2"
```

128mb Nor Flash:

```
> sudo mkfs.jffs2 --root=nfsroot -l -v -e 256 -c 12 -o
emerald.rootfs.nor128.jffs2
```

Note: Filesystem compression can be turned off with adding '-x zlib -x rtime'

Note: If you get a segmentation fault during filesystem creation, make sure that all files belong to user 'root'.

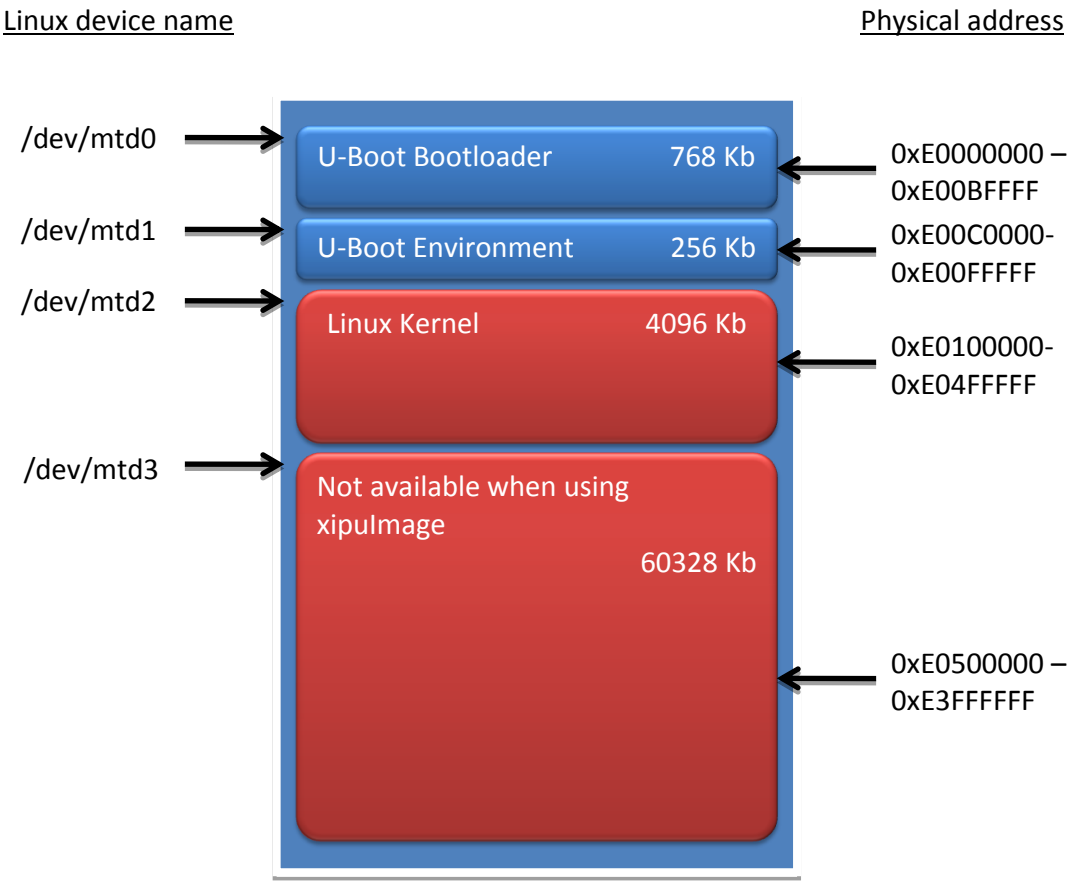
```
> sudo chown root –R nfsroot
> sudo chgrp root –R nfsroot
```

5 NOR-/NAND-Flash usage

5.1 NOR-Flash

5.1.1 Partitions

The NOR-Flash contains four partitions as shown in the image below.



5.1.2 Installation

This topic describes how to update the emerald target with new versions of bootloader, linux kernel or root filesystem.

5.1.2.1 U-Boot update

First download the updated Bootloader-image to the target system:

```
emerald> tftp 80000000 u-boot.emerald.{release}.{version}.bin
```

Now delete the flash:

```
emerald> erase e0000000 e00bffff
```

Update the flash by copying the downloaded image, the variable ‘filesize’ is updated by the tftp command:

```
emerald> cp.b 80000000 e0000000 ${filesize}
```

5.1.2.2 Linux Kernel update

First download the updated Kernel-image to the target system:

```
emerald> tftp 80000000 uImage.emerald.{release}.{version}
```

Now delete the flash:

```
emerald> erase e0100000 e04fffff
```

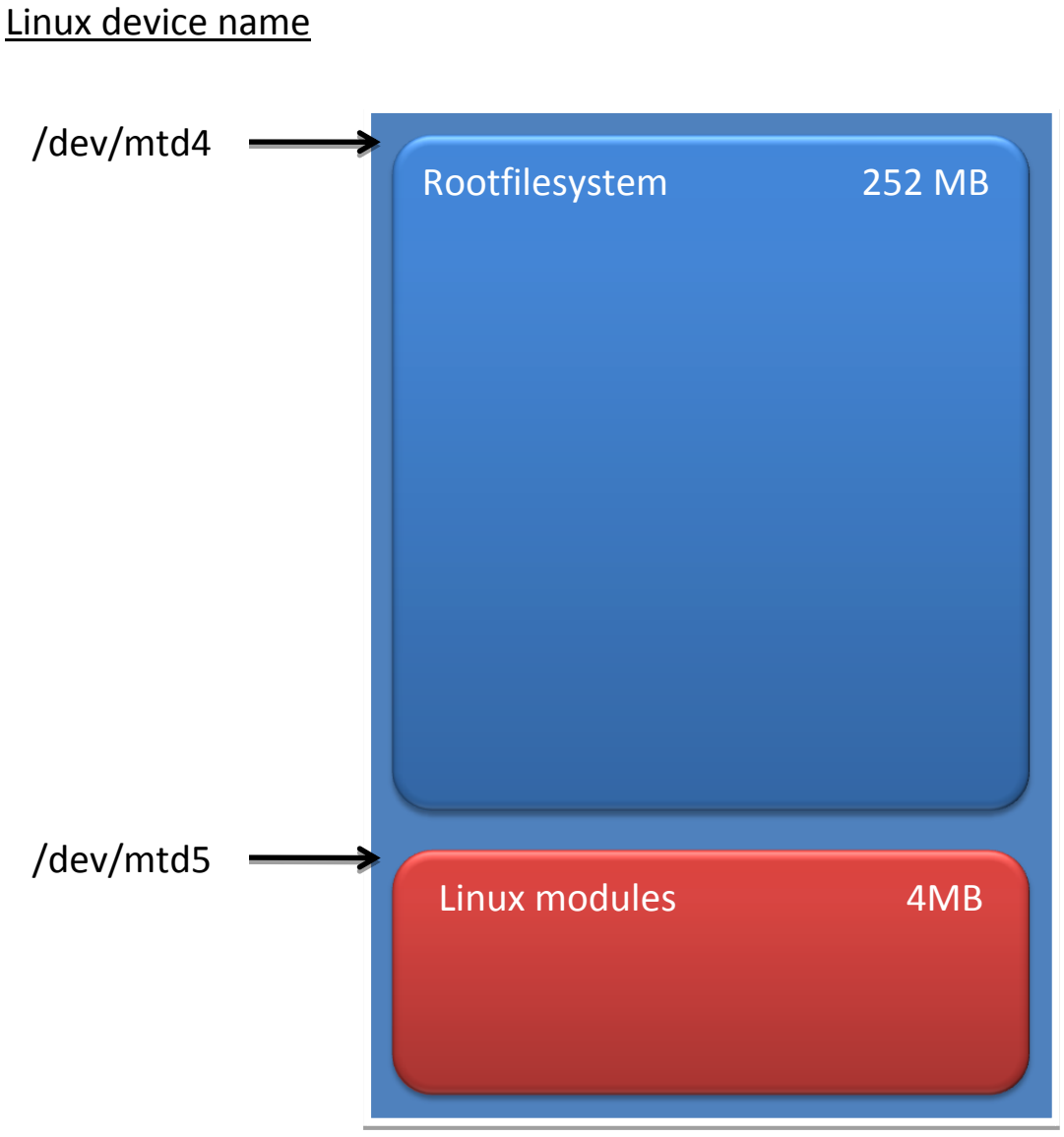
Update the flash by copying the downloaded image, the variable ‘filesize’ is updated by the tftp command:

```
emerald> cp.b 80000000 e0100000 ${filesize}
```

5.2 NAND-Flash

5.2.1 Partitions

The NAND-Flash contains two partitions as shown in the image below.



5.2.2 Installation

5.2.2.1 Root filesystem update

First download the updated root filesystem image to the target system:

```
emerald> tftp 80000000 emerald.rootfs.nand.{release}.{version}.jffs2
```

Now delete the flash:

```
emerald> nand erase clean 0 fc00000
```

Update the flash by copying the downloaded image, the variable ‘filesize’ is updated by the tftp command:

```
emerald> nand write 80000000 0 ${filesize}
```

5.2.2.2 Linux Kernel modules update

First download the updated kernel-modules-image to the target system:

```
emerald> tftp 80000000 emerald.modules.nand.{release}.{version}.jffs2
```

Now delete the flash:

```
emerald> nand erase clean fc00000
```

Update the flash by copying the downloaded image, the variable ‘filesize’ is updated by the tftp command:

```
emerald> nand write 80000000 fc00000 ${filesize}
```